PATENT SPECIFICATION

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PROVISIONAL SPECIFICATION

Improvements in Axial Flow Compressors, Turbines and the like

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, and FRANK MORGAN OWNER, a British Subject, both of Stock Exchange Buildings, St. Nicholas Street, in the City and County of Bristol, do hereby declare the nature of this invention to be as follows:—

This invention relates to axial flow compressors, turbines and the like and has for its object to provide an improved construction of rotor therefor. Such rotors are usually operated at a high speed so that they are subjected to high mechanical stresses, and the particular object of the invention is to provide a construction in which adequate strength can be secured with a minimum weight, and convenience in manufacture and assembly.

According to this invention a rotor for axial flow compressors, turbines and the like comprises a plurality of disc-drum units which are assembled co-axially side by side, each unit comprising a drum flanged or otherwise formed radially at its ends to abut the adjacent units and also being formed with one or more integral discs extending from the curved surface of the drum and carrying the rotor blades at their peripheries. The blades may be formed integrally with the discs aforesaid thereby obviating the necessity for complicated constructions for mounting the blades in the discs.

The various disc-drum units aforesaid may be bolted together separately each to the adjacent units or they may all be bolted together and to the end supports on the shafts by bolts extending through the whole assemblage.

In one embodiment of this invention which will now be described by way of example, each disc-drum unit of the rotor carries one set of blades. Each unit comprises a drum-like portion which is of an axial length appropriate to the blade dimensions of the machine, and each drum is provided at its ends with inwardly directed radial flanges. A drum-like construction of rotor is advantageous in providing the maximum stiffness and simplicity of construction, but it is desirable that the drum should be of small diameter on account of the centrifugal stresses to which it is subjected, and in the disc-drum units according to this invention the diameter of the drum is of the order of half the over-all diameter of the rotor. At the middle of the length of each of the said drum portions, an outwardly extending disc is provided, this being integral with the drum and the blades are formed integrally with this disc or may be secured on it if so desired.

The disc-drum units are preferably all of the same diametrical dimensions as to the drum portions and disc portions, so that when assembled side by side coaxially with the shaft, the inwardly directed flanges on the various drum portions abut one another endwise. They may be secured by bolting each unit individually to the adjacent units, or long bolts may be provided extending through the whole assemblage. The assemblage is mounted on the shaft by coned extensions of the shaft which are shaped to abut the assemblage of rotor units endwise, and to provide a spigot connection for centering them on the shaft.

Hoops or rings may be provided between adjacent disc-drum units to encircle the ends of the two adjacent drum parts and locate them against relative axial displacement, and to provide additional support against centrifugal loadings.

Dated this 15th day of January, 1945.

BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

COMPLETE SPECIFICATION

Improvements in Axial Flow Compressors, Turbines and the like

We, THE BRISTOL AEROPLANE COMPANY LIMITED, a British Company, and FRANK MORGAN OWNER, a British Subject, both of Stock Exchange Buildings,

[Price

St. Nicholas Street, in the City and County of Bristol, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to axial flow compressors, turbines and the like of the type in which the rotor has a plurality of disc-drum units which are assembled co-axially side by side and which carry the rotor blades spaced around their peripheral surface. Such rotors are usually operated at a high speed so that they are subjected to high mechanical stresses, and the particular object of the invention is to provide a construction in which adequate strength can be secured with a minimum weight, and convenience in manufacture and assembly.

According to this invention we provide a rotor for axial flow compressors, turbines and the like of the type set forth wherein each disc-drum unit comprises a drum portion and one or more integral discs extending outwardly from the peripheral surface of the drum and carrying the rotor blades, said units being bolted together to form a hollow drum by which the rotor assembly is solely supported.

Specific embodiments of the present invention will now be described by way of example with reference to the accompanying drawings whereof:

Figure 1 is a longitudinal section through a part of a rotor of an axial flow compressor in accordance with the present invention;

Figure 2 is a view in the direction of arrow A of Figure 1 showing a part of the rotor;

Figure 3 shows a detail of a part of the compressor shown in Figure 1;

Figure 4 is a modification of the arrangement shown in Figure 3;

Figures 5, 6 and 7 are longitudinal sections through a part of a rotor showing further constructional arrangements for assembling the disc-drum units.

Referring to Figure 1 of the accompanying drawings: the rotor comprises a plurality of disc-drum units generally indicated by the reference numeral 10, a shaft 11 by which the rotor is driven and a plurality of blades 12 which are carried by the rotor. Each disc-drum unit 10 comprises a drum-like portion 13 which has an axial length greater than the blade dimensions and an outwardly extending disc 14 which is centrally disposed of the drum portion 13 and formed integrally therewith. The blades 12 are carried by the disc portion 14 of the disc-drum units 10. The rotor is assembled by mounting the disc-drum units 10 side-by-side and passing through the drum portion 13 thereof a plurality of bolts 15 which extend throughout the length of the rotor and the outwardly flanged portions 16 of the shaft 11. The bolts are suitably provided with nuts so that when they are in position the disc-drum units 10 may be clamped together and to the shaft 11 through the medium of the flanges 16. It will be appreciated that a plurality of bolts 15 are provided which are spaced peripherally around the rotor.

A drum-like construction of rotor as described is advantageous in providing the maximum stiffness and simplicity of construction but it is desirable that the drum should be of small diameter on account of the centrifugal stresses to which it is subjected and in the disc-drum units according to the invention the internal diameter of the drum is preferably of the order of half the overall diameter of the rotor as measured across the discs 14. Stiffness is imparted to the rotor by the outwardly extending disc portions 14 which are formed integrally with the drum-like portions 13.

The blades 12 are assembled in position by means of blade-root portions 17 which are adapted to engage with axially disposed slots 18 formed around the peripheral edge of the disc portions 14 of the disc-drum units 10. The blade roots 17 and slots 18 are suitably formed with inclined faces so that the blade is incapable of becoming disconnected from the rotor due to the centrifugal action to which it is subjected. Each blade abuts a distance-piece 19 (Figure 2) which is clamped between adjacent blade-root portions 17 and enters the slots 18 of adjacent disc-drum units 10 when the rotor is assembled, the purpose of the distance-pieces being to locate the blades in their appropriate position axially of the rotor and to key the adjacent disc-drum units together. The blades on each end of the rotor abut a disc member 20 which is secured to the flange 16 of the shaft 11 as by studs 21.

The bolts 15 may be adapted to carry the entire torque loading of the rotor or alternatively dowel pins such as 22 (Figure 3) may be provided for this purpose, the pins being disposed within holes 23 formed in the adjacent disc-drum unit 10, the dowel pins being peripherally spaced from and disposed between adjacent bolts 15. Alternatively sleeves 24 may be provided as shown in Figure 4 through which the bolt 15 passes.

In the construction as shown in Figure 5 the drum-like portion 13 of each disc-drum unit 10 is provided with inwardly directed radial flanges 25 which are

adapted to abut one another endwise when the rotor is assembled. The disc-drum units 10 are secured together by bolts which pass through the inwardly directed radial flanges 25 and the end disc-drum units are similarly attached to the driving shaft by bolts passing through a radial flange of each end unit and the flange 16 of the driving shaft.

Preferably certain of the bolts (as at 26) are adapted to secure together four disc-drum units whilst certain other bolts (27) are adapted to secure a pair of adjacent disc-drum units together. The bolts 26 and 27 extend in a line axially of the rotor as shown in Figure 5 and the next adjacent line of bolts is arranged so that the bolts 27 are in a staggered relationship to that shown.

The method of mounting the blades to the disc portion of each disc-drum unit 10 is similar to that already described with reference to Figures 1 and 2.

In the arrangement shown in Figure 6 the disc-drum units 10 are of similar construction to those shown in Figures 1 and 2 as also is the method of mounting the blades on the disc portion 14 of each disc-drum unit. The disc-drum units are clamped together and secured to the flanges of the driving shaft by a plurality of bolts 28. Each bolt 28 is adapted to pass through three or more disc-drum units to form a group assembly which is secured to the next adjacent pair of group assemblies by the bolts in the next peripherally spaced line thereof.

In the arrangement shown in Figure 7 the disc-drum units are generally of the same construction to that shown in Figure 5, in this case however adjacent radial flanges 25 are clamped together by individual, associated bolts 27. The method of securing the rotor blades to the disc portion of each disc-drum unit 10 is as described above.

The rows of distance-pieces 19 lying between adjacent rows of blades may be replaced by rings or hoops if so desired.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A rotor of the type set forth wherein each disc-drum unit comprises a drum portion and one or more integral discs extending outwardly from the peripheral surface of the drum and carrying the rotor blades, said units being bolted together to form a hollow drum by which the rotor assembly is solely supported.

2. A rotor as claimed in claim 1, wherein the disc-drum units are bolted together separately each to the adjacent units.

3. A rotor as claimed in claim 1 wherein the disc-drum units are bolted together and to the end supports on the rotor shaft by bolts extending across two or more of said units.

4. A rotor as claimed in claim 3 wherein all the disc-drum units of the rotor are secured together and to the end supports on the rotor shaft by bolts extending through the whole assemblage.

5. A rotor as claimed in any preceding claim wherein the drum portion of each disc-drum unit is provided with a pair of spaced inwardly directed radial flanges through which said bolts pass.

6. A rotor as claimed in claims 2, 3 and 4 wherein torque carrying devices are disposed between adjacent disc-drum units.

7. A rotor as claimed in claim 6, wherein each torque carrying device is constituted by a dowel pin which is received by adjacent disc-drum units, said dowel pins being disposed peripherally around the drum portion of said units and between the clamping bolts.

8. A rotor as claimed in claim 6 wherein each torque carrying device is constituted by a sleeve which is received by adjacent disc-drum units and the clamping bolts pass through said sleeves.

9. A rotor as claimed in any preceding claim, wherein the rotor blades are separately mounted around the peripheries of the disc portions of the disc-drum units and distance-pieces are provided between adjacent pairs of axially spaced blades to key adjacent disc-drum units together and locate said blades against relative axial displacement.

10. A rotor as claimed in any preceding claim, wherein the rotor blades are separately mounted around the peripheries of the disc portions of the disc-drum units and rings or hoops are provided between rows of said blades to engage the root portion thereof and locate them against relative axial displacement.

11. A rotor as claimed in claim 1 and substantially as described with reference to Figures 1 and 2 of the accompanying drawings.

12. A rotor as claimed in claim 1 and substantially as described with reference to Figure 5 of the accompanying drawings.

13. A rotor as claimed in claim 1 and substantially as described with reference to Figure 6 of the accompanying drawings.

14. A rotor as claimed in claim 1 and substantially as described with refer-

ence to Figure 7 of the accompanying drawings.

Dated this 15th day of January, 1946.
BOULT, WADE & TENNANT,
111 & 112, Hatton Garden,
London, E.C.1,
Chartered Patent Agents.

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[This Drawing is a reproduction of the Original on a reduced scale.]

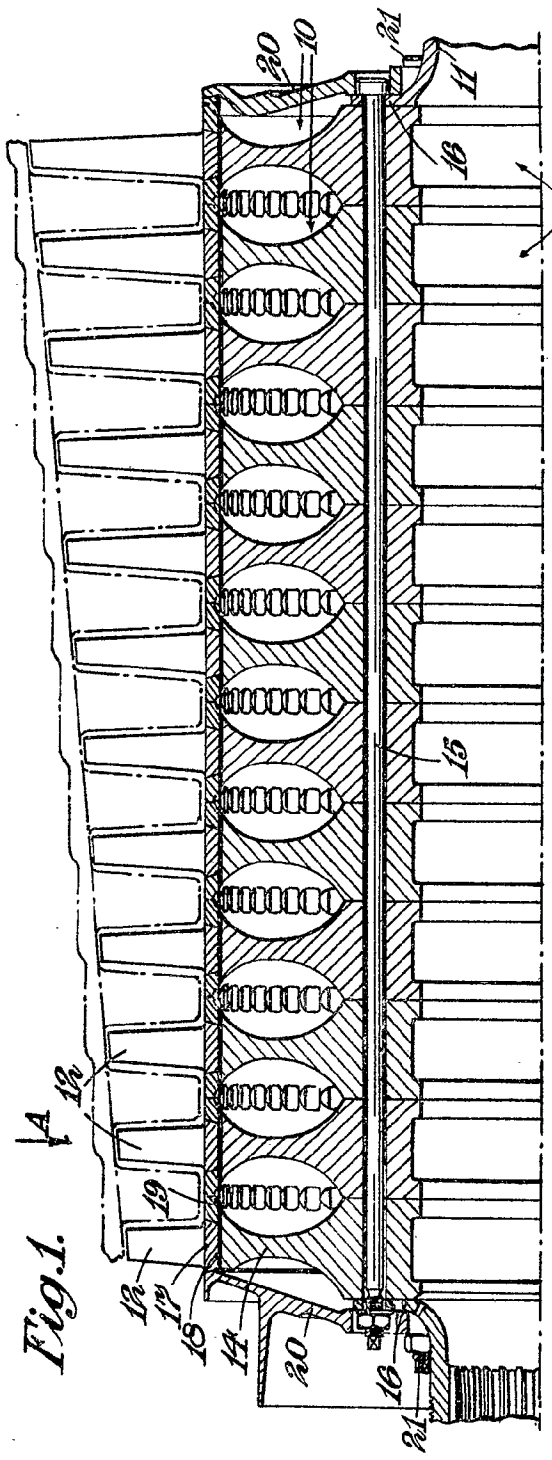

Fig. 1.

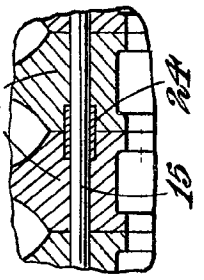

Fig. 4.

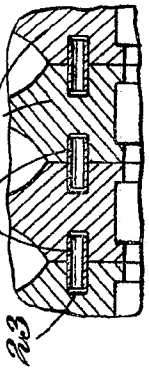

Fig. 3.

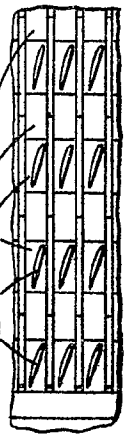

Fig. 2.

[This Drawing is a reproduction of the Original on a reduced scale.]

Fig.5.

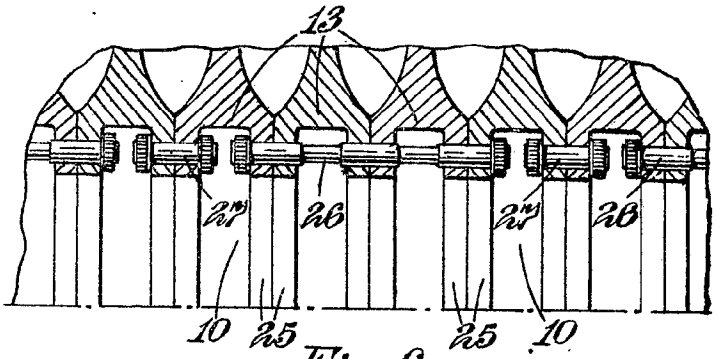

Fig.6.

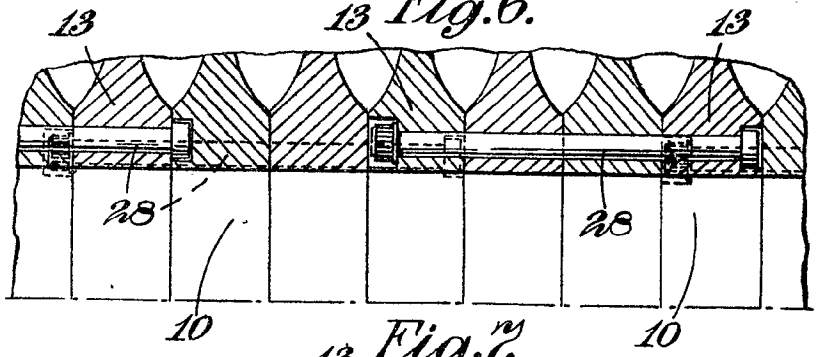

Fig.7.